DSN Aperture Enhancement Program (DAEP)

Jet Propulsion Laboratory
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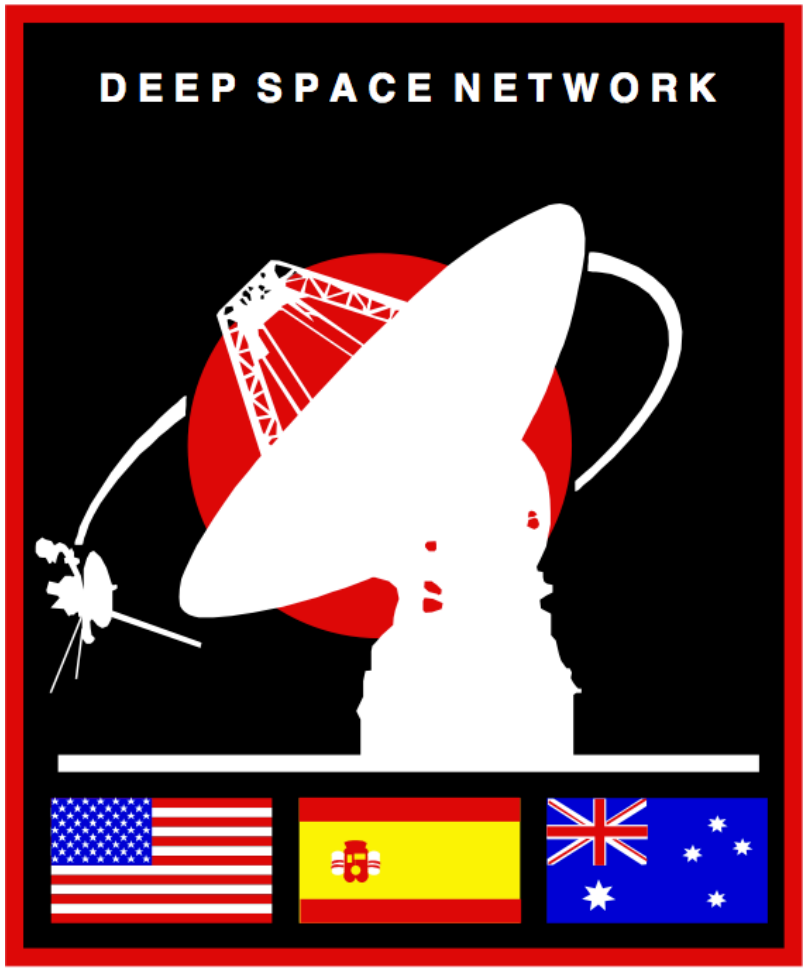
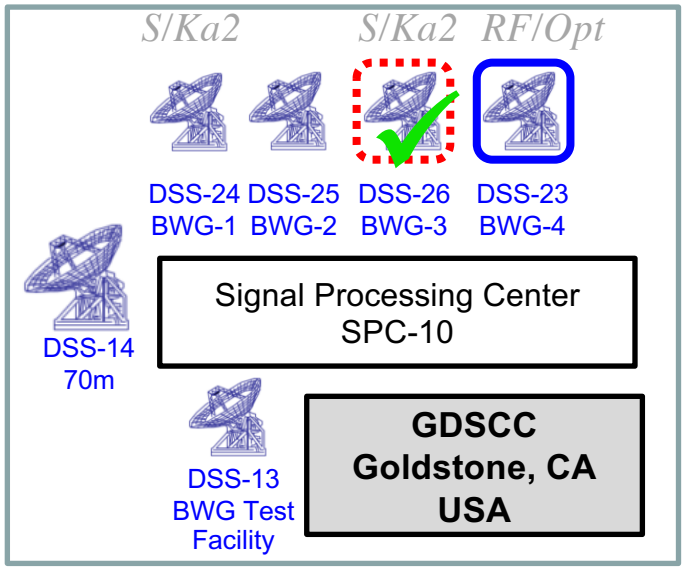
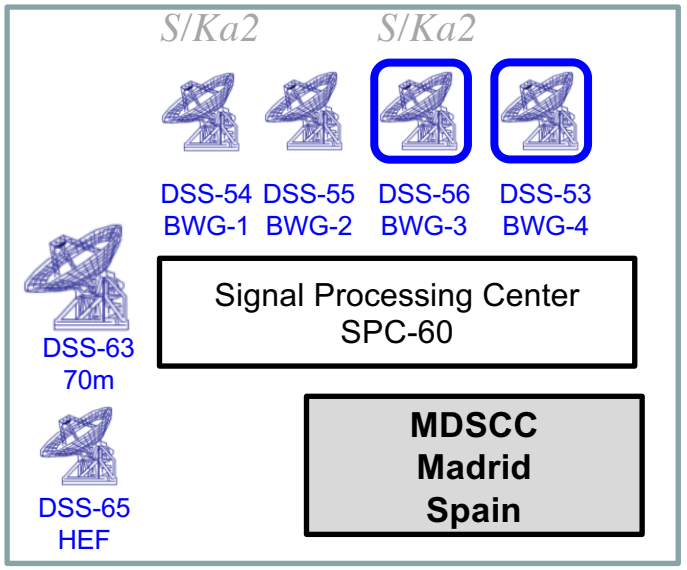
DSN Aperture Enhancement Project (DAEP)

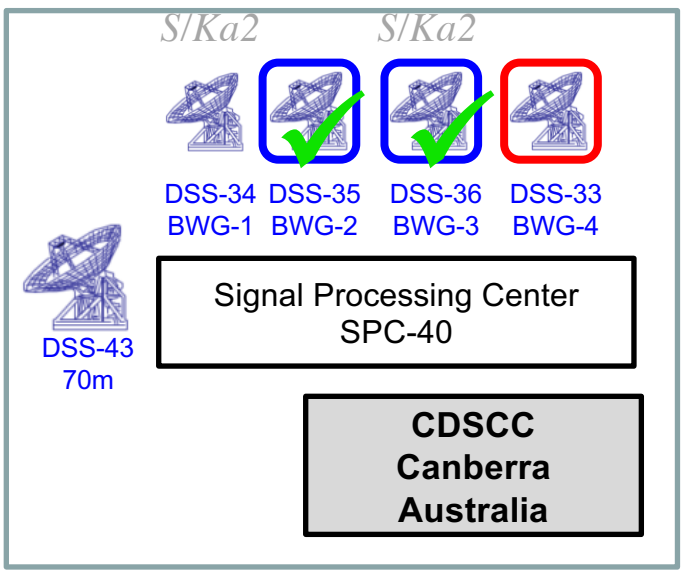
- Add capability to DSN to meet growing need.
- Construct an array of four, 34m Beam Waveguide Antennas at each of the DSN's communications complexes.
- Can be arrayed to backup 70m capability.
- Project began in 2009
- Scheduled to complete in 2026

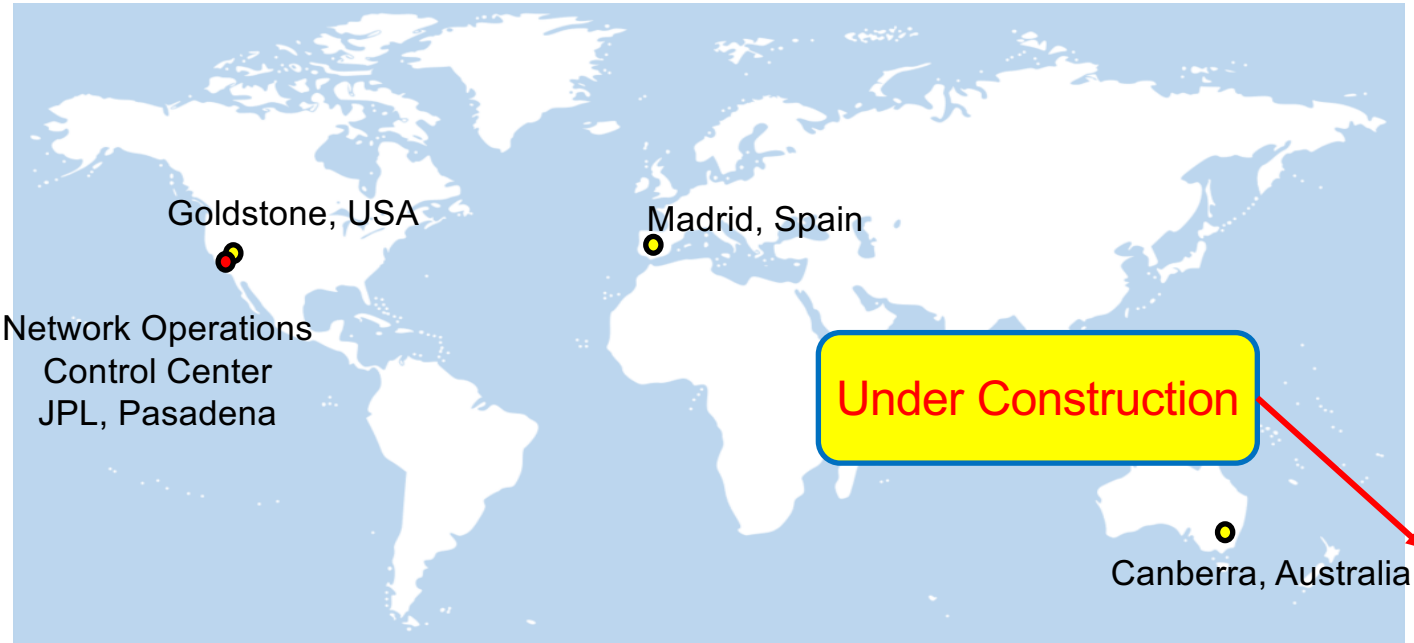


Baseline DAEP Rollout Roadmap









DAEP Developments

80-kW *TX Only*

80-kW BWG

20-kW BWG

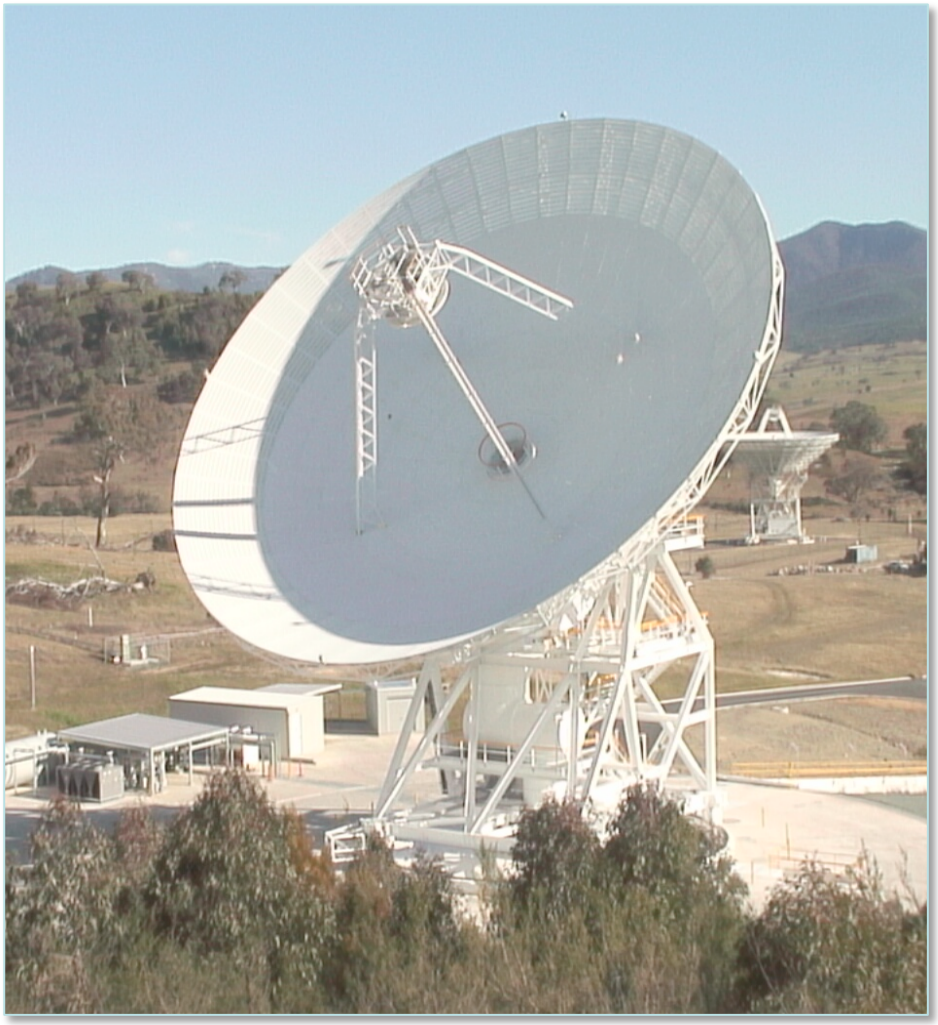
S S-Band Up/Dn

Ka2 26-GHz Dn

✓ Complete

Station	XX/Ka	S	Ka2	Optical
DSS-26		10/2017	12/2020	-
DSS-35	10/2014	-	-	-
DSS-36	10/2016	10/2016	11/2021	-
DSS-56	09/2020	09/2020	09/2020	-
DSS-53	06/2021	-	-	-
DSS-23	10/2024	-	-	12/2025
DSS-33	10/2026	-	-	
DSS-XX				10/2026

DSS-35 and DSS-36 at CDSCC



DSS-35 Delivered in 2014

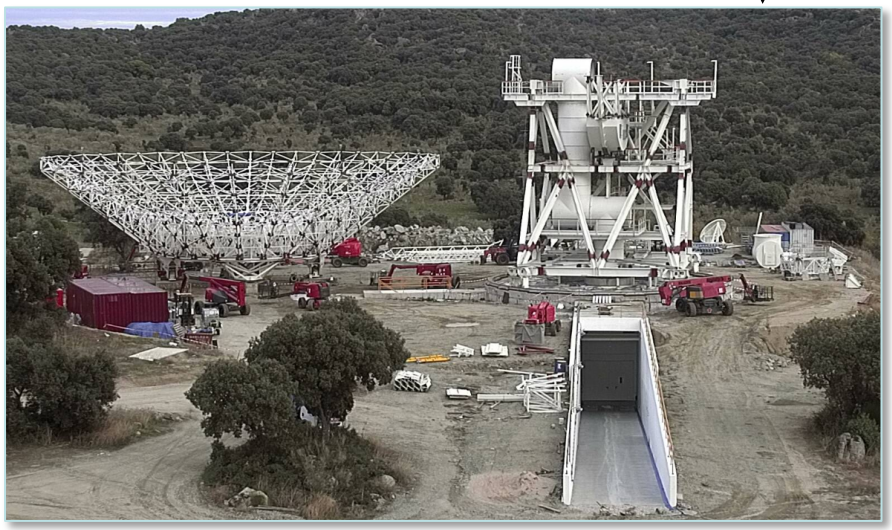
DSS-36 Delivered in 2016

DSS-56 Construction

Excavation complete in 2016

Concrete pedestal pour begins 2017

Pedestal complete 2018



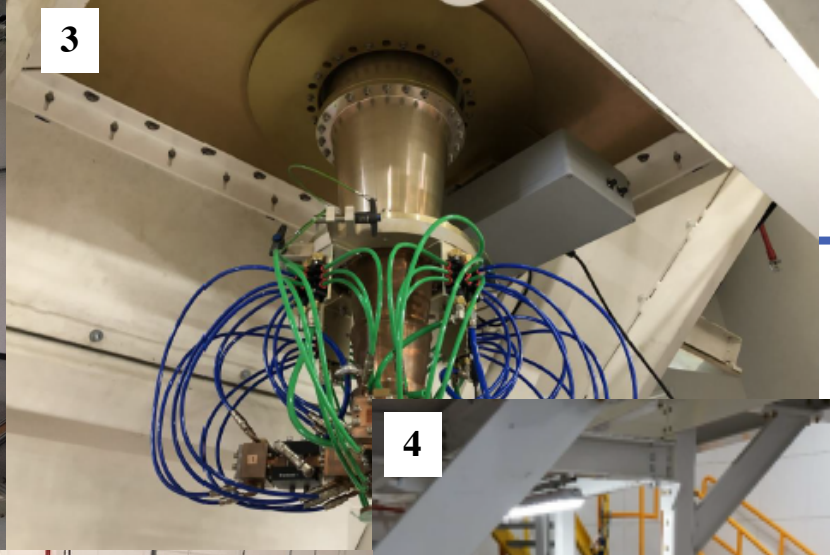
Antenna erection 2018 - 2019

Reflector lift 2018

DSS-56 Construction

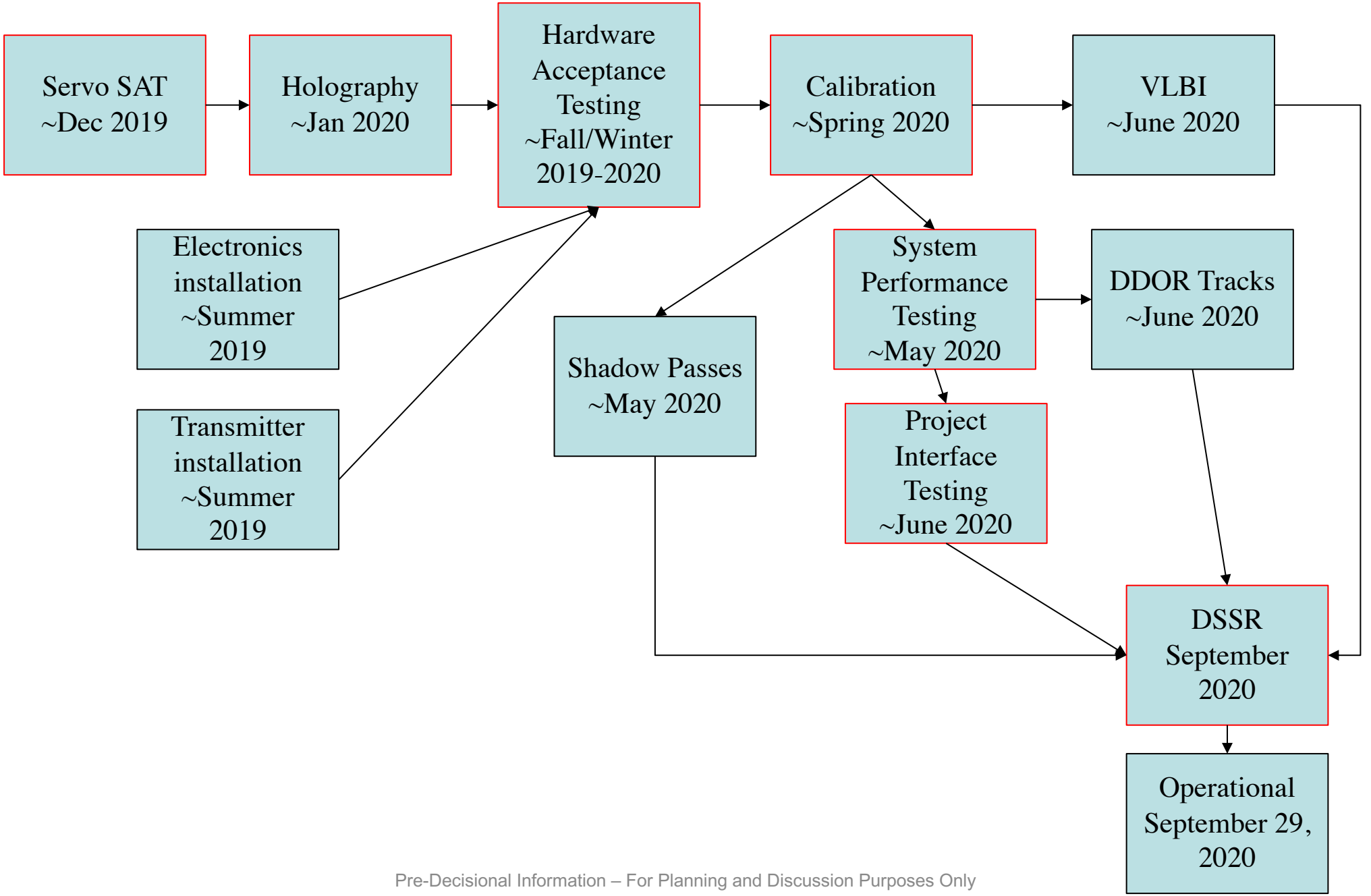
- Facilities installation began 2018
- Facilities will complete at the end of 2019
- Panels installed in 2019
- Final mechanical alignments completed October 2019
- Electronics II&T began July 2019
- Delivery 29-Sept-2020

DSS-56 II&T



1. Cabling
2. Transmitter Testing
3. X/X/Ka Feed Installed
4. X/X/Ka LNA Installed
5. Electronics installation
6. Staging S-Band Feed Installation
7. X/X/Ka Feed Network
8. Ka2 Horn Installed

DSS-56 Electronics Installation and Test

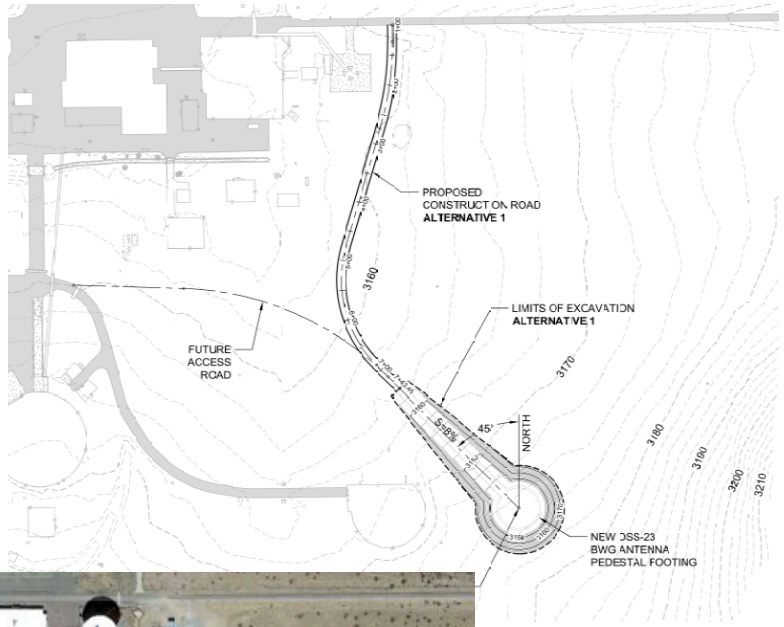


DSS-53

- Pedestal complete 2018
- Antenna erection began 2018
- Reflector lift complete Aug 2019
- Antenna construction complete March 2020
- Facilities installations began Sept 2019 and will complete July 2020
- Electronics II&T will begin June 2020
- Delivery June 10, 2021

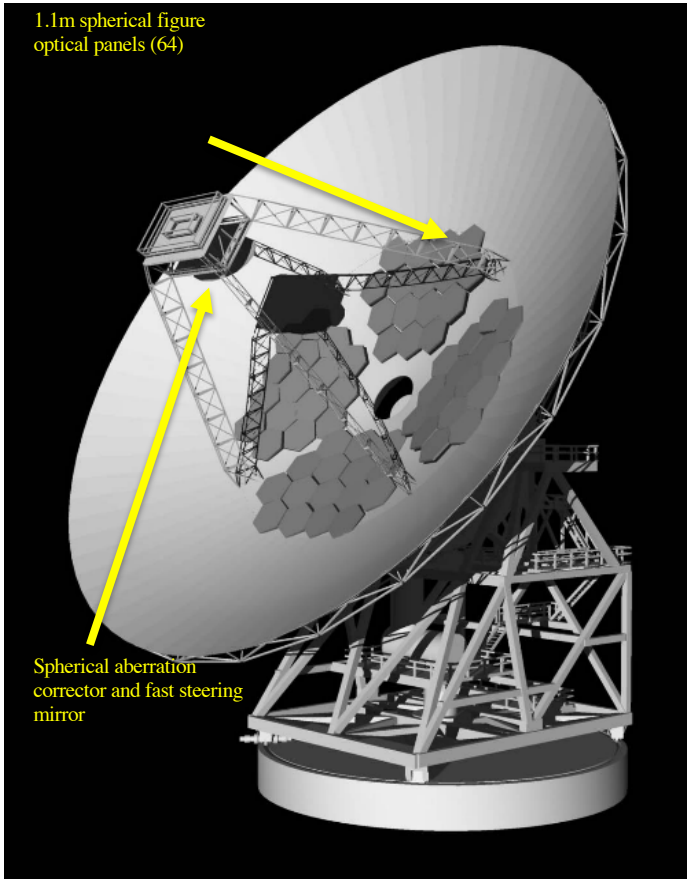
Up Next – DSS-23 at Goldstone

- DSS-23 will be located in Apollo Valley
  - 20 kW
  - XX/Ka
  - First Hybrid RF/Optical
- Site selection and GeoTech evaluations complete
- Preliminary layout and excavation design will complete soon
- Major contracting for antenna construction will take place in 2020
- RF Antenna Operational 10/2024
- Optical Operational 12/2025

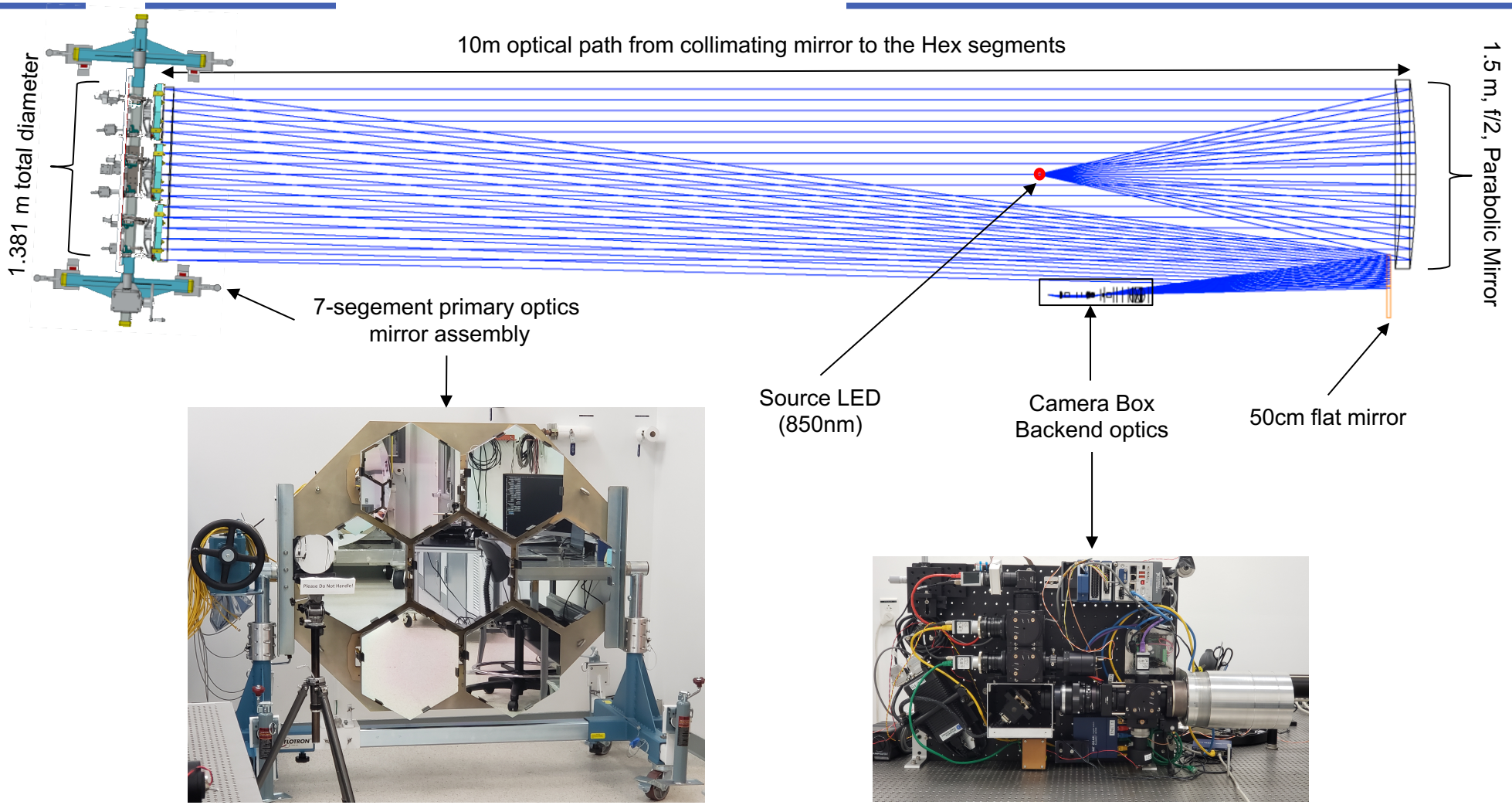


RF/Optical

- Low-cost, small (~1m), actuated, spherical glass mirrors form 8m optical aperture on a DSN 34m beam waveguide antenna
  - Superconducting photon counting optical detector at apex
- DSN hybrid RF-Optical antenna leverages DSN infrastructure at ~1/2 cost of dedicated optical ground terminals
- Simultaneous RF and optical comm (night and day)
  - X-band uplink/downlink + optical downlink from one spacecraft
  - 0.6dB loss in X-band gain from accommodating optical platform
- 250 Mbps optical downlink (at Mars opposition, nighttime operation, DSOC-like optical transceiver)
  - > 60x X-band downlink
  - Meets Human Exploration 230 Mbps Mars requirement
- 500 Mbps downlink by arraying two DSN 8m optical apertures
- FY19/20 work delivers 7-element prototype to DSS-13
  - Observation campaigns starting September 2020
- 8m aperture integration on DSS-23 starts FY 24
  - Observation campaigns starting January 2024
  - Expected to become operational FY26
- Available for Psyche comm demos 2022-2023 (and beyond) as well as Artemis comm demos

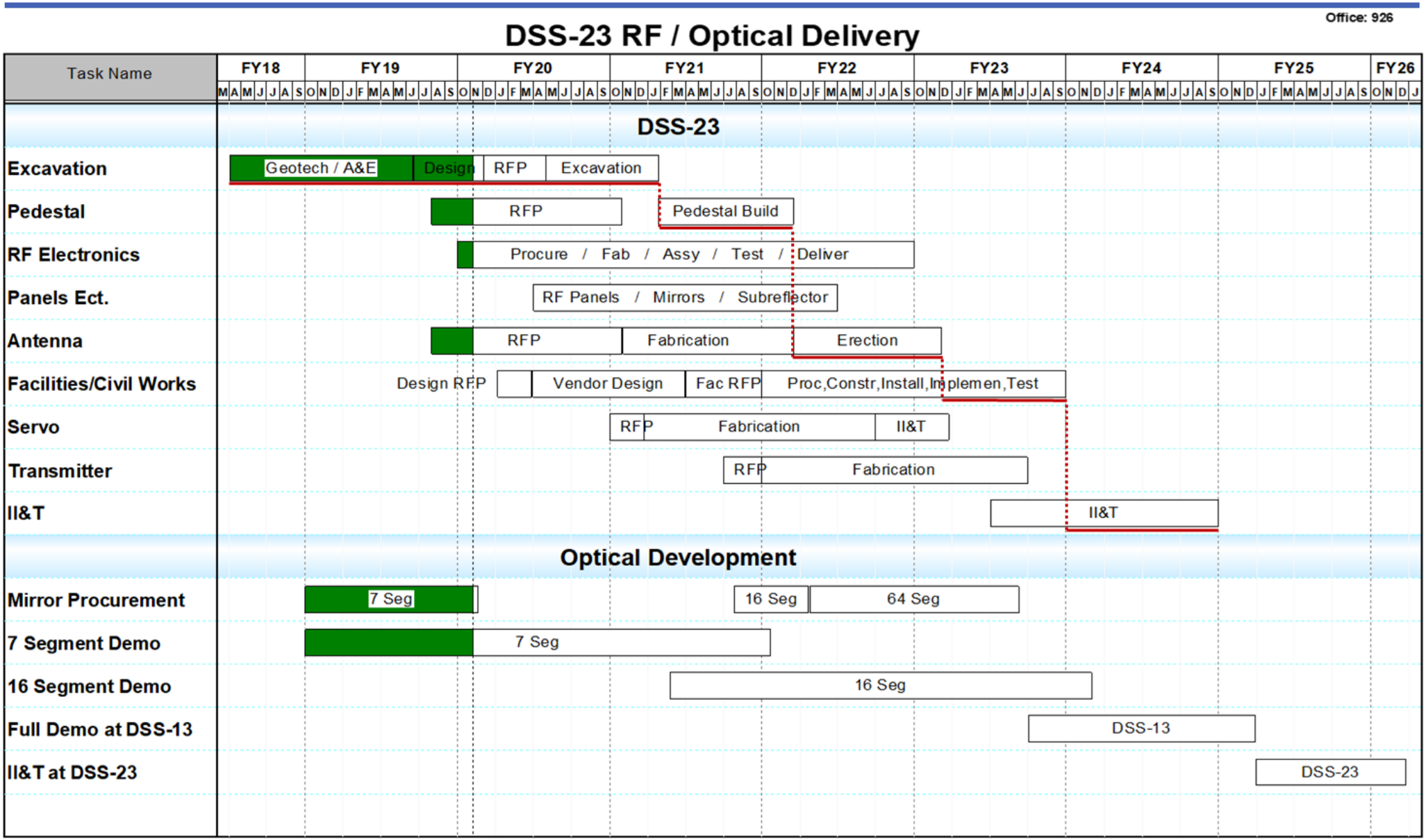


Accomplishments: 7-Segment Integration and Test



- 7-segment integration and test underway at JPL: illustrated components will be integrated onto DSS-13 summer 2020
- Setup above is for planewave illumination of 7-segment system (radius of curvature = 24.4m, focal length = 12.2m)
  - Used for testing mirror array alignment and checkout of backend optics
  - Can be reconfigured for radius of curvature measurement and individual mirror alignment

DAEP – GDSCC DSS-23 Schedule



Summary

- DSS-56 (Madrid)
  - Construction nearly complete
  - II&T underway
  - Delivery to operations scheduled for 29-Sept-2020
- DSS-53 (Madrid)
  - Construction well underway
  - II&T will start this summer
  - Delivery to operations scheduled for 10-June-2021
- DSS-23 (Goldstone)
  - Groundbreaking in early 2020
  - Major construction contracting getting started
  - Delivery to operations 1-Oct-2024
  - Optical development underway
  - Will be operational 23-Dec-2025
- DSS-33 (Canberra)
  - Would begin in 2022 for delivery in 2026